

# CATEGORY 1

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 FACIL:50-389 St. Lucie Plant, Unit 2, Florida Power & Light Co.      05000389  
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 RECIPIENT NAME      RECIPIENT AFFILIATION

SUBJECT: LER 99-002-00: on 990311, SG ECT error causes operation with condition prohibited by TS. Caused by deficiencies in data analysis guideline instructions. Licensee will change data analysis guidelines for lead analysts. With 990407 ltr.

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Florida Power & Light Company, 6351 S. Ocean Drive, Jensen Beach, FL 34957

April 7, 1999

L-99-86  
10 CFR § 50.73

U. S. Nuclear Regulatory Commission  
Attn: Document Control Desk  
Washington, D. C. 20555

Re: St. Lucie Unit 2  
Docket No. 50-389  
Reportable Event: 1999-002-00  
Date of Event: March 11, 1999  
SG ECT Error Causes Operation with a  
Condition Prohibited by Technical Specifications

The attached Licensee Event Report 1999-002 is being submitted pursuant to the requirements of 10 CFR § 50.73 to provide notification of the subject event.

Very truly yours,

J. A. Stall  
Site Vice President  
St. Lucie Nuclear Plant

JAS/EJW/GRM  
Attachment

cc: Regional Administrator, USNRC Region II  
Senior Resident Inspector, USNRC, St. Lucie Nuclear Plant

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**LICENSEE EVENT REPORT (LER)**

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<b>FACILITY NAME (1)</b> St. Lucie Unit 2	<b>DOCKET NUMBER (2)</b> 05000389	<b>PAGE (3)</b> Page 1 of 6
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**TITLE (4)**  
SG ECT Error Causes Operation with a Condition Prohibited by Technical Specifications

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
03	11	1999	1999	002	00	04	07	1999	FACILITY NAME	DOCKET NUMBER
<b>OPERATING MODE (9)</b>			<b>THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)</b>							
1			20.2201(b)			20.2203(a)(2)(v)		X	50.73(a)(2)(i)	50.73(a)(2)(viii)
<b>POWER LEVEL (10)</b>			20.2203(a)(1)			20.2203(a)(3)(i)			50.73(a)(2)(ii)	50.73(a)(2)(x)
100			20.2203(a)(2)(i)			20.2203(a)(3)(ii)			50.73(a)(2)(iii)	73.71
			20.2203(a)(2)(ii)			20.2203(a)(4)			50.73(a)(2)(iv)	OTHER
			20.2203(a)(2)(iii)			50.36(c)(1)			50.73(a)(2)(v)	Specify in Abstract below or in NRC Form 366A
			20.2203(a)(2)(iv)			50.36(c)(2)			50.73(a)(2)(vii)	

**LICENSEE CONTACT FOR THIS LER (12)**

<b>NAME</b> George R. Madden	<b>TELEPHONE NUMBER (Include Area Code)</b> (561) 467 - 7155
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**ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines) (16)**

During the St. Lucie Unit 2 refueling outage 11 (SL2-11) steam generator inspection in November 1998, the tube at Row 49 Line 85 in steam generator (SG) 2B was plugged due to a wear-induced indication that penetrated 47% through wall, exceeding the plugging limit of Technical Specification 4.4.5.4.a.6. Upon review of historical data, it was determined that this indication was present, but not identified during the SL2-9 and SL2-10 examinations, and that the depth of the indication was essentially unchanged during this period of operation. Therefore, this tube exceeded the plugging limit, but remained in service during operating cycles 9 and 10. Detection and subsequent plugging of this tube indication resulted from improvements in the data analysis and controls implemented for the SL2-11 inspection. Lead analysts did not inform FPL that this indication was not identified during the prior examinations. The missed detection was identified during the post outage review activities.

Corrective actions include: changing data analysis guidelines for lead analysts to report conditions to FPL that may indicate a repairable degradation was not reported in a prior examination; modifying data analysis guidelines for wear-induced degradation to include instructions to screen the 100 kHz differential and 100 kHz absolute channels in addition to the 400/100 kHz differential mix channel, and report flaw-like indications; and including the wear indications that were identified during the SL2-11 inspections, but not reported in SL2-10 inspections, in the training and testing of data analysis personnel.

LICENSEE EVENT REPORT (LER)  
TEXT CONTINUATION

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
St. Lucie Unit 2.	05000389	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	Page 2 of 6
		1999	- 002	- 00	

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Event Description

On March 11, 1999, a post outage review of the steam generator (SG) [EIIS:AB:SG] tube degradation trends was being prepared for the fall 1998 refueling outage (SL2-11) steam generator examination report. It was noted that a wear-induced indication in the tube at Row 49 Line 85 of SG 2B was reported as 47% through wall and did not show any evidence of growth based on comparison to the SL2-10 examination data. This tube was plugged during the SL2-11 outage. This review confirmed that this indication was present in the SL2-10 examination data, and measured approximately the same depth, but was not reported. Although the lead review team (LRT) analysts (contractors) had made this same determination during the SL2-11 examination, it was not brought to the attention of the FPL representative. A more extensive review on March 12, 1999 determined that the indication was also present in the SL2-7, SL2-8 and SL2-9 examination data and was not reported by either the primary or secondary analysts (contractor). This review showed that the indication did not exceed the plugging limit (40% through wall) of plant Technical Specifications until the SL2-9 and later examinations. In the SL2-11 examination, the indication was not reported by the primary analyst (contractor), but was identified by the secondary analyst (contractor) through the use of a computer data screening system (CDS). The CDS system uses pre-established screening parameters that are qualified to detect degradation that is known or postulated to exist in the SGs. During the SL2-11 examination, the CDS system parameters were enhanced to screen for potential free-span cracking, which has been reported during previous examinations in the St. Lucie Unit 1 (original SGs), SONGS, and Calvert Cliffs SGs. The enhanced screening parameters used for free-span cracking overlapped the same region of the tube bundle in which the diagonal support wear-induced indications occur, and resulted in detection of the wear-induced indication that previously was not reported.

Cause of the Event

A barrier analysis was completed to determine the causes that contributed to this event. The causes for not reporting the indication in the SL2-10 examination were determined to be; 1) deficiencies in data analysis guideline instructions, and 2) inadequate data analyst training. In addition, the data analysis guideline did not instruct lead analysts (contractor) to report conditions to FPL that may indicate that a repairable degradation was not reported in prior examinations. This would provide earlier identification of potential problems.

A review of industry qualified examination techniques provided through EPRI shows that, for wear-induced indications, screening of the 400/100Khz differential mix channel is one of several acceptable techniques. Latitude is given for the user to specify additional channels to be screened for confirmation and to provide additional instructions. This information has been shared with EPRI for their review.

With the exception of the added instructions to screen the 100Khz differential channel for free-span cracking in SL2-11, the data analysis guideline in the SL2-10 and SL2-11 examinations were identical with respect to the screening and reporting of wear-induced indications. The guideline requires that the indication appear flaw-like on the 400/100 kHz differential mix channel, or on the 100 kHz absolute channel. A review of SL2-11 data shows this indication maintains flaw-like characteristics considered typical of wear-induced degradation on the 100Khz differential and 100Khz absolute channels, but does not maintain them in the 400/100Khz differential mix

LICENSEE EVENT REPORT (LER)  
TEXT CONTINUATION

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
St. Lucie Unit 2	05000389	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	Page 3 of 6
		1999	- 002	- 00	

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channel. The apparent lack of flaw-like characteristics in the 400/100Khz differential mix channel may be attributable to a longer and more gradual taper associated with some diagonal support wear-induced indications. This would explain the lack of flaw-like characteristics in the 400/100Khz differential mix channel, and provide an explanation why the indication was not reported during previous examinations. The guideline does provide latitude to report indications not specifically addressed or described within the guideline (Section 15.8), yet the indication remained unreported. In retrospect, the guideline should require data analysis personnel to report suspected wear-induced indications if any of the above channels appear flaw-like. This logic should be applied to both primary and secondary analysis reviews.

The individual analysts (contractor) that reviewed the data for this indication had previous St. Lucie Unit 2 experience as well as similar plant experience, and are from reputable organizations. Furthermore, their performance demonstration test results do not indicate a problem with detection or reporting of wear-induced indications. Also, data analysts (contractor) are typically limited to 8-10 hour shifts to reduce fatigue. No specific examination date, vendor organization, or work shift can be identified as a significant contributor to this event. This supports the conclusion that potential inadequacies exist in the instructions provided in the data analysis guideline, and the site specific training and testing of data analysis personnel for reporting of wear-induced indications, rather than in personnel or equipment related issues.

The current guideline does not specifically prompt the lead review analysts to report conditions to FPL that may indicate that a repairable degradation was not previously reported in a prior examination. Although this would not have eliminated the fact that the indication was not reported, it did delay the evaluation of potential problems. This again appears to be an oversight in the data analysis guideline instructions.

Analysis of SG examination data is performed in accordance with written instructions and protocol that are provided in FPL data analysis guidelines. Prior to each examination, data analysis personnel (contractor) are indoctrinated, trained, and tested to demonstrate proficiency in application of guideline instructions. Data analysis personnel are also required to pass an EPRI standardized training and testing program for *Qualified Data Analyst*. The data analysis process at FPL incorporates independent primary and secondary analyses for all data acquired. Secondary analysis utilizes computer data screening (CDS) methods to provide added assurance that all indications are reported. A team of resolution analysts (contractor) dispositions differences between primary and secondary analyses. Lead review teams (LRT) (contractor) review the resolution team output for consistency in application of guideline instructions, select indications for diagnostic examinations, select in-situ testing candidates and provide final input to the tube plugging list.

In addition to routine analysis as discussed above, reviews are completed to evaluate growth trends, assess detection performance, provide data analyst feedback, and ensure that all indications reported in a prior examination are addressed in the current examination. The lead review analysts (contractor) are instructed to use historical data to evaluate current outage results. This is typically accomplished using the data segment recall (DSR) function provided in the analysis software, or by use of raw data available on optical disks or hard drives. DSR is the first course of

LICENSEE EVENT REPORT (LER)  
TEXT CONTINUATION

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
St. Lucie Unit 2	05000389	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	Page 4 of 6
		1999	- 002	- 00	

TEXT (If more space is required, use additional copies of NRC Form 366A) (17)

action since all indications reported in the prior examination should be available in this format. The alternative is the raw data on disk. The absence of a flaw history on DSR for an indication could be used to initiate further evaluations to determine if the indication was present, but not reported in the previous examination, and if it appeared to exceed the tube-plugging limit. This in turn should alert lead personnel (contractor) to inform the FPL representative.

Current screening instructions in the data analysis guideline have identified more than 500 tubes that are affected by wear-induced degradation, which is typical for the steam generator design installed at St. Lucie Unit 2. Current instructions, however, do not account for indications that lack flaw-like characteristics in the 400/100 kHz differential mix channel, but maintain flaw-like characteristics in the 100 kHz differential or 100 kHz absolute channels. A review of indications that have remained unreported in prior examinations shows that only one indication (Row 49 Line 85 in SG 2B) has exceeded the tube-plugging limit of Plant Technical Specifications during previous operation. The additional screening requirements implemented for free-span cracking appear to be effective in reporting this form of wear-induced degradation, and should be required in the analysis instructions. In addition, data analysis guidelines should be modified to instruct lead analyst personnel to report conditions to FPL that may indicate that repairable degradation is not being reported in prior examinations. Data analyst training and testing should also be revised to include wear-induced indications that have not been reported in prior examinations.

**Analysis of the Event**

This event is reportable under 10 CFR 50.73(a)(2)(i)(B) as any operation or condition prohibited by the Technical Specifications (TS). TS 3.4.5 states that each steam generator shall be operable. The applicable ACTION statement states that with one or more steam generators inoperable restore the inoperable steam generator to operable status prior to increasing T<sub>1</sub> above 200°F. TS Surveillance 4.4.5.0 states that each steam generator shall be demonstrated operable by performance of the required augmented inservice inspection program. TS 4.4.5.4.a.6 Plugging Limit means the imperfection depth at or beyond which the tube shall be removed from service and is equal to 40% of the nominal tube wall thickness. TS 4.4.5.4.a.7 states that a tube is unserviceable if it leaks or contains a defect large enough to affect its structural integrity in the event of an operating-basis-earthquake (OBE), a loss-of-coolant-accident (LOCA), or a steam line or feedwater line break.

Contrary to the above, on March 12, 1999, FPL identified that SG 2B operated throughout operating cycle 9 and 10 with the tube at Row 45 Line 85 having a 47% through wall wear indication.

**Safety Significance**

The steam generator tubes are described in UFSAR section 5.4.2.1.3. The tubes are designed to allow for wall thinning and the generators are designed to minimize the potential for denting. The UFSAR discusses considerations for localized corrosion leading to tube degradation, which is the predominant degradation mechanism seen in the industry.

St. Lucie Unit 2 Design Basis Document, Volume 9, discusses reactor coolant system integrity. It also discusses the structural integrity requirements for steam generator tubes, and provides an assessment of maximum allowable tube wall

LICENSEE EVENT REPORT (LER)  
TEXT CONTINUATION

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
St. Lucie Unit 2	05000389	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	Page 5 of 6
		1999	- 002	- 00	

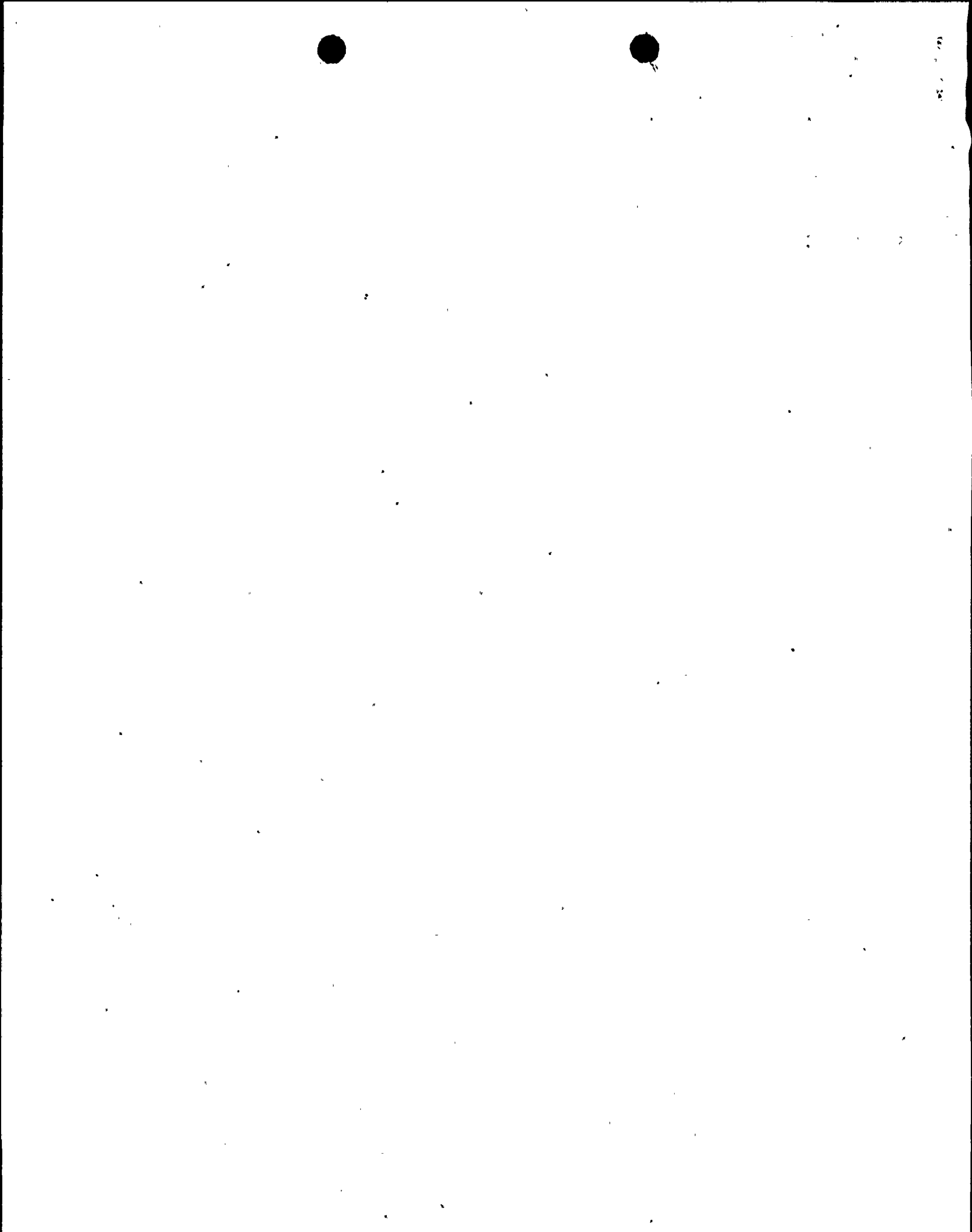
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degradation that can sustain the loading imposed by normal operation and postulated accident conditions. This shows that a maximum allowable tube wall degradation of 63% is within the design basis for the steam generator tubing.

Mechanical wear in the Unit 2 steam generators is a result of a design flaw in the fabrication of the units. The design flaw was discovered following a primary to secondary leak at another plant and at St. Lucie Unit 2 during Cycle 2 shortly thereafter. In the tube leak event at St. Lucie 2, the leakage was limited to approximately 20 gallons per day (gpd). Air ejector monitors readily detected it, and the unit was shutdown within a few days. The historical tube leaks at SONGS Unit 2 and St. Lucie Unit 2 occurred in a region of the tube bundle that was analyzed to be susceptible to rapid growth rates. Preventative tube plugging was completed at St. Lucie Unit 2 to remove the susceptible tubes from service. Therefore, it is currently unlikely that wear degradation would result in through wall penetration and primary to secondary leakage in one or two cycles of operation. Extensive inspections have been completed at each refueling outage since that time, and the rate of wear has been low.

After implementation of preventive plugging measures, it was not expected that the rate of wear-induced damage would result in a through wall penetration after one or two cycles of operation. Furthermore, the potential effects associated with a through wall penetration scenario have been shown to have no effect on safety. A design basis steam generator tube rupture (SGTR) accident, as described in Chapter 15 of the St. Lucie UFSAR, is defined as a double-ended guillotine break of a tube that results in initial primary to secondary leak rates in excess of 300 GPM. ABB/CE has performed prototypical laboratory testing to empirically determine the leak rate from tube defects that were intended to simulate wear defects produced by tube supports. These tests showed that in all cases, when wear-initiated degradation is less than the structural limit of the tubing, primary to secondary leakage would not be expected to occur under normal operation or postulated accident conditions. Even in the majority of cases when such degradation exceeds the structural limit, a through wall penetration of this type will result in a leak rate less than one GPM, and would not suddenly leak in an uncontrolled manner. These test results have been further substantiated by the slow steady leak rates that occurred during early operation from through wall penetrations in the SONGS Unit 2 and St. Lucie Unit 2 steam generators. Therefore, the leak rates that could result from wear defects would be within the current Technical Specification limits of the unit and would, therefore, represent an operational concern but not a safety concern.

As a result, potential tube defects from mechanical wear are not considered as a possible initiating event of a SGTR accident but, rather, as a potential increase in the normal secondary system radionuclide inventory that is used as an initial condition for other Chapter 15 accident analyses. Secondary system radionuclide inventories assumed in the UFSAR Chapter 15 safety analysis are based on one percent failed fuel and a continuous one GPM primary to secondary leak rate. As discussed above, the most severe leak rates associated with typical through wall wear penetrations are typically much less than one GPM. In addition, operation with one percent failed fuel is considered highly unlikely. Hence, actual secondary system radionuclide inventories are expected to be much less than those assumed in the accident analysis. As a result, the radiological consequences associated with postulated wear-induced tube leakage will be bounded by those accidents currently described in Chapter 15 of the UFSAR.





LICENSEE EVENT REPORT (LER)  
TEXT CONTINUATION

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
St. Lucie Unit 2	05000389	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	Page 6 of 6
		1999	- 002	- 00	

TEXT (If more space is required, use additional copies of NRC Form 366A) (17)

It should also be noted that operation with a continuous one GPM primary to secondary leak rate is an unrealistic assumption. The St. Lucie 2 Technical Specifications do not permit operation if total primary to secondary leakage exceeds one GPM through all steam generators, or if leakage from any one steam generator exceeds 720 gallons per day (0.5 GPM). St Lucie performs primary system water inventory balances at least every 72 hours, which are capable of detecting leak rates of this magnitude. In addition, secondary system radiation monitors are capable of detecting increases in secondary system radiation that would result from primary to secondary leaks. In either case, an orderly reactor shutdown would likely be performed before secondary system radionuclide inventories reached the levels assumed in the accident analysis. Based on the above discussion, wear-induced degradation in the steam generators is not a safety concern.

In addition, as discussed above, maximum allowable degradation that will sustain the loading imposed by normal operation and postulated accident conditions is 63% through wall penetration. Since the degradation in Row 49 Line 85 in SG 2B was 47% through wall, it did not exceed the design basis, and structural integrity was not compromised. Therefore, the tube was not considered unserviceable as described in Plant Technical Specification Section 4.4.5.4.a.7. Based on the above discussion, the operation during cycles 9 and 10 with the degradation in the tube at Row 49 Line 85 at 47% through wall did not adversely affect the health and safety of the public.

Corrective Actions

1. Include instructions in data analysis guidelines for lead analyst personnel to report conditions to FPL that may indicate that repairable degradation has not been reported in prior examinations.
2. Modify data analysis guidelines for wear-induced degradation to include instructions to screen the 100 kHz differential and 100 kHz absolute channels in addition to the 400/100 kHz differential mix channel, and report flaw-like indications.
3. Include wear indications that were reported in SL2-11 inspections, but not reported in SL2-10 inspections, in the training and testing of data analysis personnel for future outages.

Failed Components Identified

None

Similar Events

LER 389-1998-008