

CATEGORY 1

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FACIL:50-389 St. Lucie Plant, Unit 2, Florida Power & Light Co.
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DOCKET #
05000389

SUBJECT: LER 98-006-00:on 980918,inadvertent AFAS actuation was noted.Caused by degradation of multiple AFAS power supplies. Replaced AFAS power supplies & revised procedures.With 981014 ltr.

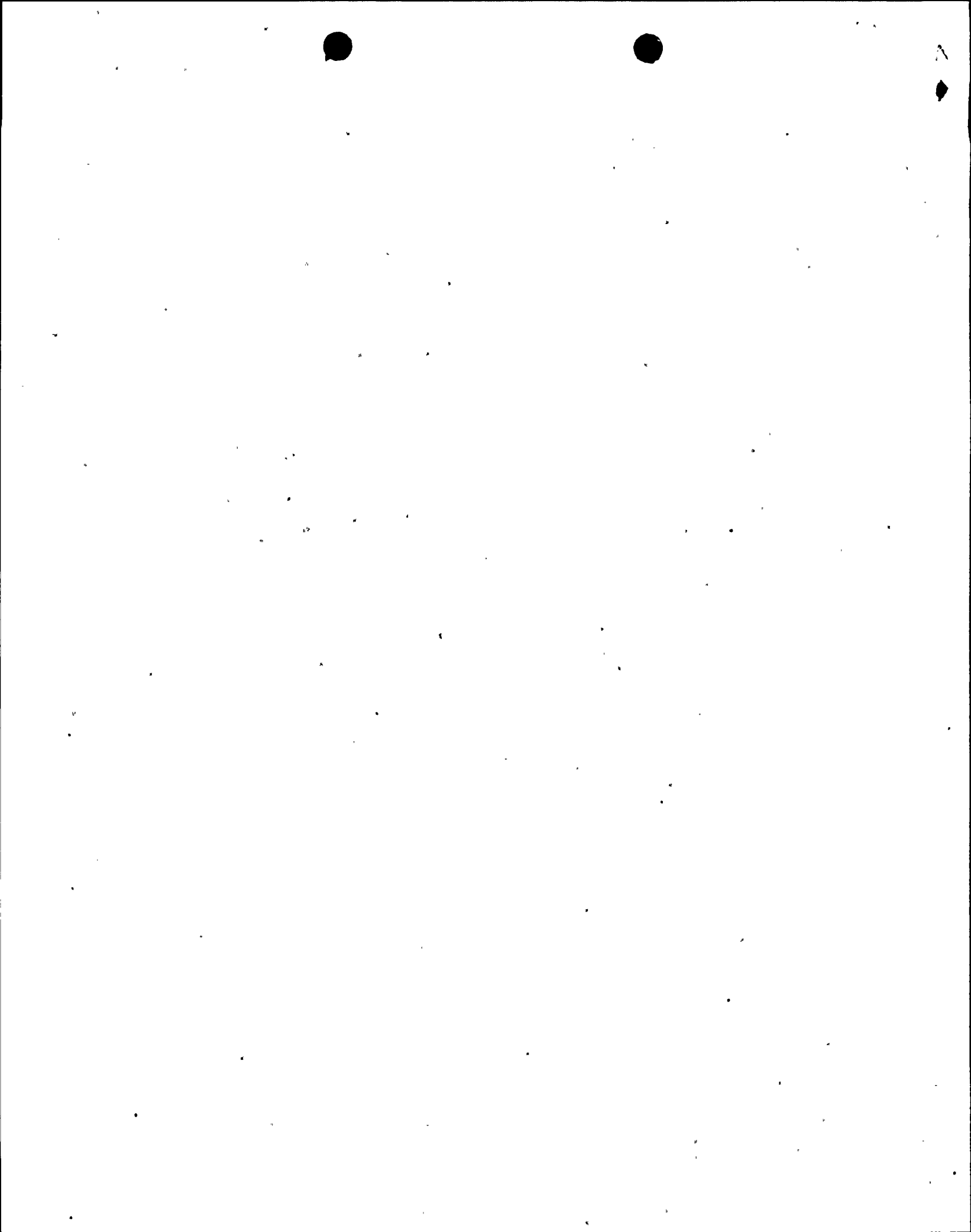
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Florida Power & Light Company, 6351 S. Ocean Drive, Jensen Beach, FL 34957

October 14, 1998

L-98-265
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: 1998-006-00
Date of Event: September 18, 1998
Inadvertent AFAS Actuation
Due to Degraded Power Supplies

The attached Licensee Event Report 1998-006 is being submitted pursuant to the requirements of 10 CFR § 50.73 to provide notification of the subject event.

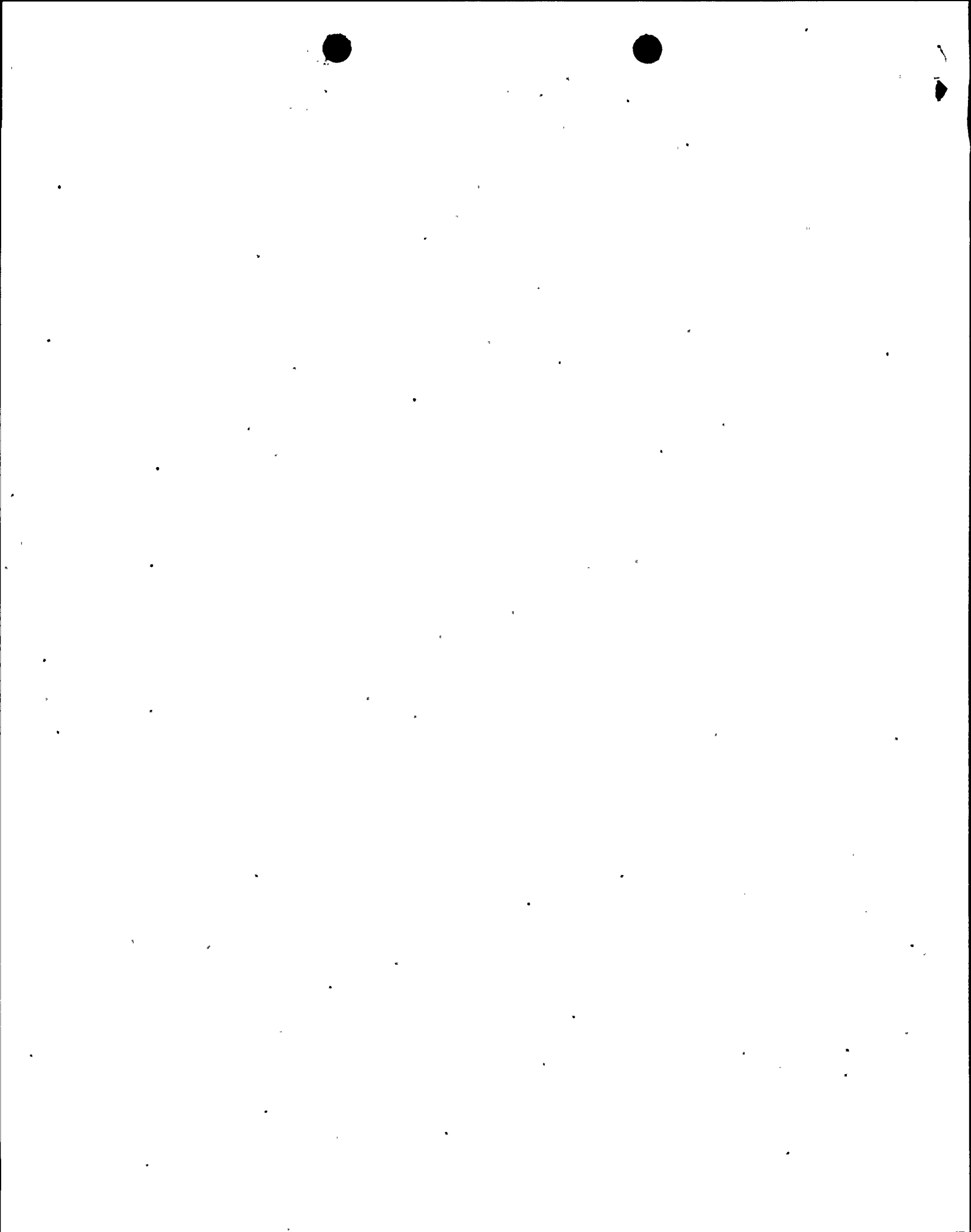
Very truly yours,

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

JAS/EJW/KWF
Attachment

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

100010
9810190278 981014
PDR ADOCK 05000389
S PDR



LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

Estimated burden per response to comply with this mandatory information collection request: 50 hrs. Reported lessons learned are incorporated into the licensing process and fed back to industry. Forward comments regarding burden estimate to the Records Management Branch (T-6 F33), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, and to the Paperwork Reduction Project (3150-0104), Office of Management and Budget, Washington, DC 20503. If an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

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TITLE (4)
Inadvertent AFAS Actuation Due to Degraded Power Supplies

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	
09	18	1998	1998	006	00	10	14	1998	FACILITY NAME	DOCKET NUMBER	
OPERATING MODE (9) 1 POWER LEVEL (10) 100 THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)											
			20.2201(b)			20.2203(a)(2)(v)			50.73(a)(2)(i)		50.73(a)(2)(viii)
			20.2203(a)(1)			20.2203(a)(3)(i)			50.73(a)(2)(ii)		50.73(a)(2)(x)
			20.2203(a)(2)(i)			20.2203(a)(3)(ii)			50.73(a)(2)(iii)		73.71
			20.2203(a)(2)(iii)			20.2203(a)(4)			X 50.73(a)(2)(iv)		OTHER
			20.2203(a)(2)(iii)			50.38(c)(1)			50.73(a)(2)(v)		Specify in Abstract below or in NRC Form 366A
			20.2203(a)(2)(iv)			50.38(c)(2)			50.73(a)(2)(vii)		

LICENSEE CONTACT FOR THIS LER (12)

NAME K. W. Frehafer, Licensing Engineer	TELEPHONE NUMBER (include Area Code) (561) 467 - 7748
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COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX
X	BA	RJX	A048	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-

SUPPLEMENTAL REPORT EXPECTED (14)				EXPECTED SUBMISSION DATE (15)		MONTH	DAY	YEAR
YES (If yes, complete EXPECTED SUBMISSION DATE).	X	NO						

ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines) (16)

On September 18, 1998, St. Lucie Unit 2 was in Mode 1 at 100 percent power. St. Lucie maintenance personnel were performing the Auxiliary Feedwater Actuation Signal Monthly Functional Test Procedure 2-0700051. At approximately 0840, a partial AFAS-1 actuation occurred while performing step 9.4.1.C of the procedure on AFAS channel D. The actuated components correctly responded to the initiation signals that were generated by the AFAS cabinet for the AFAS-1 actuation. Operations instructed the maintenance personnel to stop conducting the surveillance on AFAS channel D and then proceeded to secure the running auxiliary feedwater pumps after resetting the AFAS signal.

The cause of AFAS-1 actuation was determined to be degradation of multiple AFAS power supplies characterized by excessive AC ripple on the power supply output. These power supply degradations are typically due to end of life and are random in nature.

Corrective actions included replacing AFAS power supplies, procedure changes to verify power supply operation prior to surveillances, and investigating the need for preventative maintenance program requirements for AFAS power supplies.

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		YEAR 1998	SEQUENTIAL NUMBER - 006	REVISION NUMBER - 00	

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

Description of Event

On September 18, 1998, St. Lucie Unit 2 was in Mode 1 at 100 percent power. St. Lucie maintenance personnel were performing the Auxiliary Feedwater [EIIS:BA] Actuation Signal (AFAS) Monthly Functional Test Procedure, 2-0700051. The test procedure had been satisfactorily completed on AFAS channels A, B, and C. At approximately 0840, a partial AFAS-1 actuation occurred while performing step 9.4.1.C of the procedure on AFAS channel D. This step of the test procedure is designed to test the matrix relay logic circuits, and testing of the AD logic matrix was ongoing.

Operations instructed the maintenance personnel to stop conducting the surveillance on AFAS channel D and then proceeded to secure the running auxiliary feedwater (AFW) pumps after resetting the AFAS signal.

The actuated components correctly responded to the initiation signals that were generated by the AFAS cabinet for the AFAS-1 actuation.

TABLE OF COMPONENTS ACTUATED BY AFAS-1

Actuation Channel	Component Actuated	Latched /Cycle	As found Condition
MA	Start 2A AFW Pump	Lat	Started
MA	Open MV-09-9	Cyc	No change
MA	Open MV-09-12	Cyc	No change
MA	Close HCV-09-1A	Cyc	No change
MA	AFAS-1 Lockout relay	Lat	Actuated
MB	Open MV-08-13	Lat	Opened
MB	Close HCV-09-1B	Cyc	No change
MB	AFAS-1 Lockout relay	Lat	Actuated
MC	Open SE-09-2	Cyc	No change
MC	AFAS-1 Lockout relay	Lat	Actuated
MD	Open SE-09-4	Cyc	No change
MD	AFAS-1 Lockout relay	Lat	Actuated

AFW pump 2A started, and the steam supply valve for the AFW pump 2C (MV-08-13) opened. It should be noted that the auxiliary feedwater isolation valves remained closed following the actuation, and there was no water injected into the steam generators.

Cause of Event

The cause of AFAS-1 actuation was determined to be degradation of multiple AFAS power supplies [EIIS:BA:RJK] characterized by excessive AC ripple on the power supply output. The multiple channel AFAS-1 actuation was due to interaction between a degraded MD test power supply and other degraded AFAS bistable power supplies. These power supply degradations are typically due to end of life and are random in nature.

Analysis of Event

The event is reportable under 10 CFR 50.73(a) (2) (iv) as actuation of any engineered safety feature (ESF). The four (4) hour non-emergency report to the NRC was made on September 18, 1998.

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AFAS Design Description

The AFAS actuation logic initiates auxiliary feedwater to a steam generator on a low level signal, following a preset system response period. The initiation of AFW to a steam generator with a low level condition will be prevented by the AFAS logic if the steam generator or its associated auxiliary feedwater supply header is identified as being ruptured. The AFAS actuation logic isolates auxiliary feedwater flow to a steam generator upon recovery of steam generator level. A separate auxiliary feedwater actuation signal is generated for each steam generator (AFAS-1, AFAS-2).

The AFAS logic employs three channels of initiating signals to provide a two-out-of-three initiation logic of system components. However, to enhance plant availability, a fourth channel is provided as a spare and allows by-passing of one channel while maintaining the requisite two-out-of-three logic. The instrumentation and controls for the components and equipment in AFAS channels MA, MB, MC and MD are physically separated and electrically isolated and independent of each other. This independence maintains the redundancy required to ensure the functional capability of the equipment following a design basis event which is mitigated by the AFWS.

The steam generator low level initiation signals generated in the four measurement channels (MA, MB, MC, MD) are received by four bistable comparators for each parameter. Contacts from the bistable relays of the same system in the four protective channels are arranged into six logic AND'S, designated AB, AC, AD, BC, BD and CD, which represent all possible coincidence of two combinations. Each logic matrix is connected in series with a set of four matrix output relays. Each logic matrix is powered from two separate 120v Class 1E instrument power supply buses through dual DC power supplies.

The contacts of the matrix relays are combined into four initiation circuits, one circuit per channel per AFAS. Each initiation circuit is formed by connecting six contacts (one matrix relay contact from each of the six logic matrices) in series. The six series contacts are in series with the initiation delay circuit and the initiation relays. The initiation relay outputs are combined to form the actuation logic.

The actuation logic is formed by combining the initiation circuit output signals from the four channels into a selective two-out-of-four logic within each channel. Upon actuation of this logic, the appropriate (AFAS 1 or 2) AFAS actuation relays will deenergize to control the individual AFWS components.

The actuation relays are subdivided into two categories as follows:

1. Cycling Relays - These relays control the auxiliary feedwater isolation valves and the main feedwater isolation valves that will automatically reset when the steam generator has refilled or a steam generator or feedwater header has been identified as being ruptured.
2. Latching Relays - These relays control the auxiliary feedwater pumps and the AFW system turbine inlet valves and will remain in the actuated condition until manually reset.

The AFAS simultaneously actuates the following AFW components:

1. The Auxiliary Feedwater System (AFWS) pumps and the auxiliary feedwater turbine inlet valves are latched on.

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2. The AFWS isolation valves supplying feedwater to steam generator 2A and 2B are opened and the main feedwater isolation valves are closed, but are not latched.

If the AFAS logic indicates that the steam generator or its associated auxiliary feedwater supply header is ruptured, the associated AFWS isolation valves will remain closed. Once the steam generator level has reached its high level setpoint, the AFAS trip condition will no longer be generated, and the AFWS isolation valves will close.

Analysis of Observed AFAS Actuation

Step 9.4.1.C of the (AFAS) Monthly Functional Test Procedure, 2-0700051 requires depressing and holding the matrix relay test pushbutton. When depressed, test power is applied to the hold coils of the four relays associated with that logic matrix. This test circuit arrangement is designed to allow testing of individual logic matrix relays while preventing a system actuation. When this step was performed on AFAS channel D an AFAS lockout relay indication was observed on all channels for AFAS-1. The presence of AFAS-1 lockout relay actuation on all channels indicated actuation of all latching components.

Data was taken on the test and bistable power supplies and the isolation of the test circuitry of all channels. Voltage measurements confirmed that all channel test circuitry was isolated from ground and in accordance with design. Data taken on the bistable and test power supplies indicated degraded power supplies in channel MB, MC and MD.

DATA TAKEN ON TEST POWER SUPPLIES

	Channel MA	Channel MB	Channel MC	Channel MD
Output Voltage	12.01 V	11.99 V	11.97 V	11.64 V
Ripple	0.0001 Vrms	0.0001 Vrms	0.0002 Vrms	0.701 Vrms

DATA TAKEN ON BISTABLE POWER SUPPLIES

	Power Supply	AC Ripple	Power Supply	AC Ripple	Power Supply	AC Ripple
Channel MA	PS301/302	0.004 Vrms	MA PS301	0.001 Vrms	MB PS302	0.001Vrms
Channel MB	PS301/302	0.096 Vrms	MB PS301	0.015 Vrms	MA PS302	0.463 Vrms
Channel MC	PS301/302	0.174 Vrms	MC PS301	>0.174Vrms	MD PS302	0.034 Vrms
Channel MD	PS301/302	0.005 Vrms	MD PS301	Not Taken	MC PS302	0.008 Vrms

The cause of AFAS-1 actuation was determined to be degradation of multiple AFAS power supplies characterized by excessive AC ripple on the power supply output. The multiple channel AFAS-1 actuation was due to interaction between a degraded MD test power supply and other degraded AFAS bistable power supplies. While the exact mechanism can not be duplicated, the following discussion provides an explanation for the highly unusual event. During the operation of the MD channel's matrix hold pushbutton, channel MD test power was routed to each matrix to hold and selectively trip



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each matrix. The high noise introduced by the degraded test power supply most likely interacted with the channel MD AFAS-1 time delay initiation circuits causing a 1/2 trip condition. A momentary loss of power in channel MC also occurred due to interaction of the degraded power supplies, and caused initiation in channel MC. Actuation of AFAS-1 resulted from the 2/4 condition. AFAS-1 components connected to cyclic relays did not operate due to the short duration of the power loss. ABB/CE reviewed this event with the AFAS-OEM and also concluded that the power supply degradations could cause such an event.

Assessment of Safety Significance

The AFAS system is designed to eliminate credible multiple channel failures originating from a common cause that would prevent a required AFAS from occurring. The failure modes of redundant channels and the conditions of operation that are common to them are analyzed to assure that a predictable common failure mode does not exist.

As demonstrated by this event, multiple degraded AFAS power supplies or AFAS power supply failures may cause undesired AFAS actuations. However, AFAS is a fail safe system, and AFAS actuations result in the plant being placed in a safe condition. Therefore, this event had no adverse impact on the health and safety of the public.

Corrective Actions

1. All Unit 2 AFAS power supplies were checked for acceptable voltage and AC ripple. Power supplies MA-PS302, MC-PS301, and MD-PS306 (Test Power) were replaced in that they were outside of specification, and the surveillance was completed without further incident.
2. A revision to both Unit 1 and Unit 2 I/C Monthly Procedures 1-0700051 and 2-0700051, "Auxiliary Feedwater Actuation System Monthly Functional Test," is in progress that will require checking power supply voltage and ripple prior to conducting testing.
3. Engineering is reviewing the AFAS power supply failures and will establish a preventive maintenance or replacement program for critical supplies.

Other Information

Similar Occurrences:

None

Failed Components Identified:

None

