CATEGORY 1

REGULATORY INFORMATION DISTRIBUTION SYSTEM (RIDS)

ACCESSION NBR:9904090141 DOC.DATE: 99/04/07 NOTARIZED: NO DOCKET #
FACIL:50-335 St. Lucie Plant, Unit 1, Florida Power & Light Co. 05000335

AUTH.NAME	AUTHOR AFFILIATION
FREHAFER,K.W.	Florida Power & Light Co.
STALL,J.A.	Florida Power & Light Co.
RECIP.NAME	RECIPIENT AFFILIATION

SUBJECT: LER 99-001-00:on 990309,discovered inadequate design & IST SRs for iodine removal sys (IRS).Caused by original design inadequacies & personnel error.NaOH tank vent valve V07233 was tagged open.With 990407 ltr.

DISTRIBUTION CODE: IE22T COPIES RECEIVED:LTR 1 ENCL 1 SIZE: 11
TITLE: 50.73/50.9 Licensee Event Report (LER), Incident Rpt, etc.

NOTES:

	RECIPIENT ID CODE/NAME	COPIES LTTR	COPIES ENCL	RECIPIENT ID CODE/NAME	COPIES LTTR	COPIES ENCL
	PD2-3 PD	1	1	GLEAVES,W	1	1
INTERNAL:	ACRS	1	1	AEOD/SPD/RAB	2	2
	AEOD/SPD/RRAB	1	1	FILE CENTER	1	1
	NRR/DRCH/HOHB	1	1	NRR/DRCH/HQMB	1	1
	NRR/DRPM/PECB	1	1	NRR/DSSA/SPLB	1	1
	RES/DET/EIB	1	1	RGN2 FILE 01	1	1
EXTERNAL:	L ST LOBBY WARD	1	1	LMITCO MARSHALL	1	1
	NOAC POORE,W.	1	1	NOAC QUEENER,DS	1	1
	NRC PDR	1	1	NUDOCS FULL TXT	1	1

C A T E G O R Y 1 D O C U M E N T

FULL TEXT CONVERSION REQUIRED
TOTAL NUMBER OF COPIES REQUIRED: LTTR 19 ENCL 19

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

FPL

April 7, 1999

L-99-081
10 CFR § 50.73

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

Re: St. Lucie Unit 1
Docket No. 50-335
Reportable Event: 1999-001-00
Date of Event: March 9, 1999
Inadequate Design and IST Surveillance
Requirements for Iodine Removal System

The attached Licensee Event Report 1999-001 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

NRC FORM 366 (6-1998)	U.S. NUCLEAR REGULATORY COMMISSION	APPROVED BY OMB NO. 3150-0104	EXPIRES 06/30/2001

LICENSEE EVENT REPORT (LER)

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

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
St. Lucie Unit 1	05000335	Page 1 of 10

TITLE (4)

Inadequate Design and IST Surveillance Requirements for Iodine Removal System

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	09	1999	1999	- 001 -	00	04	07	1999	FACILITY NAME	DOCKET NUMBER

OPERATING MODE (9)	1	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)							
			20.2201(b)		20.2203(a)(2)(v)	X	50.73(a)(2)(i)		50.73(a)(2)(viii)
POWER LEVEL (10)	100		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)(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)

NAME	TELEPHONE NUMBER (Include Area Code)
Kenneth W. Frehafer, Licensing Engineer	(561) 467 - 7748

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
A	BE	-	-	-	-	-	-	-	-
B	BE	-	-	-	-	-	-	-	-

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 March 9, 1999, St. Lucie Unit 1 was in Mode 1 at 100 percent reactor power. While investigating a failed full flow in-service test surveillance of a vacuum breaker check valve serving the sodium hydroxide (NaOH) tank in the Unit 1 iodine removal system (IRS), FPL determined that in certain scenarios the design of the NaOH tank venting arrangement was inadequate to ensure proper post accident containment spray pH. Additionally, although a previous review of the St. Lucie IST program identified an issue with the NaOH vacuum breaker check valve full flow test considering a failure of the redundant vacuum breaker check valve, the significance of this finding was not immediately recognized.

This condition was caused by original IRS design inadequacies and personnel error. Immediate corrective actions were taken to place the IRS NaOH tank in a condition bounded by the design calculations to assure operability of the IRS.

Long term corrective actions for the IRS design inadequacies are being investigated by FPL. Additionally, FPL completed a review of check valve full flow IST surveillance criteria and no other operability or reportability issues were found.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
St. Lucie Unit 1	05000335	1999	- 001	- 00	Page 2 of 10

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

Description of the Event

On March 9, 1999, St. Lucie Unit 1 was in Mode 1 at 100 percent reactor power. During surveillance testing valve V07232, a vacuum breaker check valve [EIIS:V] serving the sodium hydroxide (NaOH) tank [EIIS:TK] in the Unit 1 iodine removal system [EIIS:BE](IRS), would not open with 15 psig nitrogen pressure applied per Data Sheet 24 of operating procedure 1-0010125A, "Surveillance Data Sheets." The redundant valve, V07231, passed its surveillance testing. While investigating the failed full flow in-service test (IST) surveillance of valve V07232, FPL determined that in certain scenarios the design of the NaOH tank venting arrangement was inadequate to ensure proper post accident containment spray pH. Additionally, a previous review of the St. Lucie IST program identified that the NaOH vacuum breaker check valve full flow test may have been inadequate to assure full flow considering a failure of the redundant vacuum breaker check valve.

System Description:

The IRS consists of (1) NaOH storage tank, (2) isolation valves, (3) NaOH flow orifices, (4) spray nozzles, and (5) system eductors. A nitrogen cover gas at approximately 3 psig is provided for the chemical (NaOH) storage tank so as to preclude deterioration of the NaOH. Sufficient instrumentation is provided to enable the operator to assess the status of the system in the standby or operational mode. Level indication is provided locally and in the control room to assess tank availability. A level alarm in the control room will indicate a NaOH tank level decrease to the low level. Four separate level switches are provided to close the solenoid valves (I-SE-07-1A, I-SE-07-1B, I-SE-07-2A and I-SE-07-2B) after the required volume of NaOH has been injected into the Containment Spray System. Temperature indication is provided locally.

The design of the IRS is based on a combination of a buffered solution of borated water and NaOH. The NaOH is stored in the chemical storage tank and proper amounts are drawn into the suction of the containment spray pumps through the use of eductors. The actual flow is indicated in the control room. Upon receipt of the containment spray actuation signal (CSAS), isolation valves open in the line to allow flow of the caustic solution to commence. The NaOH flow rate is measured by a flow orifice in the caustic line and is determined by the eductor size and the vacuum created by the containment spray pump flow. Utilizing this control system assures proportionate injection of NaOH flow throughout the transient. The NaOH injection rate is set to adjust the pH of the spray water between 8.5 and 11.0 at the containment spray nozzles. Upon reaching low-low level in the NaOH storage tank, the caustic line isolation valves close to isolate the NaOH storage tank, thereby ending injection of NaOH.

Design Bases:

The iodine removal system is designed to operate in conjunction with the containment spray system to remove radioiodines from the containment atmosphere following a loss of coolant accident (LOCA). The injection system is designed to be fully automatic yet is capable of local manual control. The iodine removal system (IRS) is designed to the following criteria:

a) Maintain the containment spray solution pH to achieve rapid absorption of radioiodines and minimal caustic corrosion of materials and protective coatings within the containment.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
St. Lucie Unit 1	05000335	1999	- 001 -	00	Page 3 of 10

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

Description of the Event (cont'd)

b) Maintain the containment spray removal system nozzle spray pH between 8.5 and 11.0 until such time that a decontamination factor (DF) of 100 is achieved.

c) Achieve a containment sump pH equal to or greater than 8.5, but less than 11.0 after all the spray chemical mixes with the available water inventory including refueling water tank (RWT), safety injection tanks, boric acid makeup tanks, and the reactor coolant system blowdown to assure retention of iodine in the sump solution.

d) Remove elemental and particulate iodines with the minimum following first order removal coefficient in accordance with WASH 1329.

Iodine Form	First Order Removal Coefficient
Elemental	10 hours-1
Particulate	0.45 hours-1

e) Minimize the possibility of precipitation of the spray solution within the system or its inadvertent introduction into the refueling water tank.

f) Be constructed of system materials that are compatible with NaOH.

g) Be seismic Category I, Quality Group B, and function under post-accident environmental conditions (based on location).

h) Perform its function following a LOCA, assuming a single active component failure.

Technical Specification 3.6.2.2 requires spray additive system to be OPERABLE in modes 1, 2 & 3 (> 1750 psia) with a specific tank volume (4010 gallons to 5000 gallons) and concentration (28.5 % to 30.5% by weight) and two spray eductors each capable of adding NaOH solution from the tank to a containment spray system pump flow.

The bases for Technical Specification 3.6.2.2 state: "The OPERABILITY of the spray additive system ensures that sufficient NaOH is added to the containment spray in the event of a LOCA. The limits on NaOH volume and concentration ensure a pH value of between 8.5 and 11.0 for the solution recirculated within containment after a LOCA. This pH minimizes the evolution of iodine and minimizes the effect of chloride and caustic stress corrosion on mechanical systems and components. The contained water volume limit includes an allowance for water not useable because of discharge line location or other physical characteristics. These assumptions are consistent with the iodine removal efficiency assumed in the accident analysis."

<u>Evaluation of NaOH Tank Venting Arrangement and Eductor Flow Requirements Against Design Bases:</u>

The specifications for tank vacuum breaking equipment must limit external positive pressure differentials to prevent tank collapse and consider the effect differential pressures will have on fluid delivery systems. Review of such issues with respect to the NaOH tank have revealed a number of design concerns with respect to the IRS.

Titration and flow element calculations provide the basis for the eductor flowrate and the Technical Specification constraints of the NaOH tank volume/concentration in support of: a) final sump pH of 8.5 to 11.0 after all water inventories reach the sump following a LOCA and b) continuous spray flow pH of 8.5 to 11.0 during injection and recirculation during a LOCA.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
St. Lucie Unit 1	05000335	1999	- 001 -	00	Page 4 of 10

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

Description of the Event (cont'd)

Each NaOH orifice plate is sized to provide a design NaOH eductor flow of 18 gallons per minute (gpm). The calculations of orifice sizing are based on a minimum NaOH tank level at atmospheric pressure to demonstrate the required flowrate is met at the end of NaOH injection. Review of the titration and orifice sizing calculations indicates that the pH range at the spray nozzle considered allowable variations in boric acid (H3BO3) and NaOH inventories, single failure of a containment spray pump, single failure of a diesel generator and the timeframe for recirculation actuation signal (RAS) initiation. For these cases, the containment spray nozzle pH varies between the upper and lower allowable pH extremes of 8.5 and 11.0. The calculations for NaOH orifice sizing consider the storage tank at atmospheric pressure; they do not consider a pressure drop for the NaOH tank vacuum breaker check valves or the overpressure condition supplied by the non-safety related nitrogen purging system. There is no margin in the calculation to account for flow variance outside the specified eductor flow range of 16.5 to 18.0 gpm.

Low pH Case:

An additional pressure drop would adversely affect spray flow low pH calculation cases. NaOH tank vacuum breaking would be required during a design basis accident if the nitrogen supply system failed. Following CSAS, NaOH flow would proceed normally and would gradually decrease as the air space expanded above the liquid service (assuming failure of the nitrogen supply system). NaOH delivery flow would decrease as the eductor became less efficient due to a lower-than-design suction side pressure. Based on the size of the vacuum breaker valves, it is likely they would cycle until the NaOH tank was isolated on low level or by manual action by Operations. Therefore, the actual containment spray nozzle pH will tend to be somewhat lower than the calculated containment spray nozzle pH.

High pH Case:

A cover gas pressure would adversely affect the spray flow high pH calculation cases. The effect of higher tank elevations or pressure on eductor flow is not modeled. Therefore, the actual containment spray nozzle pH will tend to be somewhat higher than the calculated containment spray nozzle pH.

Conclusion:

Consideration of vacuum breaker and nitrogen overpressure effects could result in exceeding the pH range of 8.5 to 11.0 for the containment spray flow following LOCA. However, the final sump pH of 8.5 to 11.0 is not dependent on the eductor flow rate and would not be adversely affected provided the total NaOH tank volume is delivered to the containment.

<u>Evaluation of the IST Requirements for the Vacuum Breaker Full Flow Test:</u>

Testing criteria for the NaOH vacuum breaking system stems from UFSAR Paragraph 6.2.6.1 which states the IRS is designed to maintain the containment spray pH at the spray nozzle between 8.5 and 11.0, achieve a containment sump pH equal to or greater than 8.5 but less than 11.0, and must perform its function following a LOCA, assuming a single active component failure. The IST program did not fully consider the effects of a single failure of a vacuum breaker valve concurrent with loss of the nitrogen overpressure system subsequent to a LOCA. The flow requirement for the vacuum breakers was based on the design basis NaOH flow of 18 +/- 1.5 GPM per train.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
St. Lucie Unit 1	05000335	1999	- 001	- 00	Page 5 of 10

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

Description of the Event (cont'd)

Considering a single failure of a check valve, a flow rate of 18 +/- 1.5 GPM was considered acceptable since the NaOH delivered to each train would be at least 50 percent of the total design flow. This flow rate would meet the design requirement for the pH of the sump contents. However, based on detailed calculations to support this LER, the requirements of the pH of the containment spray fluid exiting the spray nozzle may have been less, (7.4 vs. 8.5) than that specified in the UFSAR.

Cause of the Event

<u>NaOH Tank Venting Arrangement Inadequacies:</u>

The IRS design deficiencies were caused by inadequate consideration of all applicable NaOH tank operational conditions (i.e., the effects of tank levels, pressures, and pressure drops) by the original designers. The original IRS design approach primarily assured a final sump pH and that the design approach generally, but did not completely, assure the pH of the containment spray at the nozzles remains within the specified pH range. Based on review of the design and calculation methodology, more emphasis was placed on ensuring containment spray pH at the nozzles remained above 8.5 than assuring it remained below 11.0.

In addition, FPL is reviewing other applications of lift check vacuum breaker valves on important to safety atmospheric tanks to ensure that the design considers the effect of the pressure drop across the vacuum breakers on flow delivery. Although the St. Lucie Unit 2 IRS design also uses lift check valves as vacuum breaking devices on the chemical storage tank, buffering agent (hydrazine) addition is by the use of positive displacement chemical pumps, an arrangement that is not affected by small variations in suction line pressure.

<u>IST Surveillance Inadequacies:</u>

In 1996, FPL identified a discrepancy concerning IST surveillance criteria for a check valve in the Auxiliary Feedwater System. As part of the corrective action process, a review of the IST program was specified to review the flow requirements for other check valves in Unit 1 and Unit 2 in order to address generic implications. This review identified several potential flow rate issues. The flow rate issues were reviewed to determine if an operability concern was evident. Those issues with an evident operability concern were addressed via Condition Report, and the remainder were tracked via commitment tracking to closure. The operability review did not identify the NaOH tank vacuum breaker as an operability concern. The operability review did not consider the effects of a single failure of a vacuum breaker valve concurrent with loss of the nitrogen overpressure system subsequent to a LOCA.

The flow requirement for the vacuum breakers was based on the design basis NaOH flow of 18 +/- 1.5 GPM per train. Considering a single failure of a check valve, a flow rate of 18 +/- 1.5 GPM was considered acceptable since the NaOH delivered to each train would be at least 50 percent of the total design flow. This flow rate would meet the design requirement for the pH of the sump contents. However, based on detailed calculations to support this LER, the requirements of the pH of the containment spray fluid exiting the spray nozzle may have been less (7.38 vs. 8.5) than that specified in the UFSAR.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
St. Lucie Unit 1	05000335	1999	- 001 -	00	Page 6 of 10

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

Cause of the Event cont'd)

In order to ensure that the remaining check valve full flow IST issues were properly screened, FPL performed another review. No other issues were identified as an operability concern or potentially reportable issue.

Analysis of the Event

The two reportable issues associated with the condition of the NaOH system are the inadequate IST requirements and the inadequate design of the NaOH vacuum breaking system.

Inadequate IST Testing Issues:

IST program test criteria required that the subject valves be able to pass 74 SLPM (equivalent to 19.5 gpm) to provide vacuum relief to the NaOH tank during delivery of NaOH to the containment spray system eductors. Assuming the single failure of one vacuum breaker valve, the redundant valve should be able to pass the required air flow for the eductors to supply the correct amount of NaOH to two trains of containment spray. The IST program did not test this capability. Thus, the IST criteria did not ensure that a containment spray pH between 8.5 and 11.0 was maintained following LOCA as required by the UFSAR. Although the IST program is not covered by Technical Specification 4.0.5, it is a required program under Section 6.0 of the Technical Specifications. Because the IST program did not previously incorporate the correct vacuum breaking test criteria to assure system operability, this condition is reportable under 10 CFR 50.73(a)(2)(i)(B) as "any operation or condition prohibited by the plant's Technical Specifications."

Inadequate Vacuum Breaking Design:

Review of the design calculations related to eductor flow has revealed that the system may not be able to maintain required spray pH under all scenarios. The IRS design basis calculations assumed atmospheric gas pressure above the NaOH liquid level. Consideration of negative or positive overpressures may result in an inability to maintain containment spray flow pH within the specified band of 8.5 to 11.0, specifically:

- The calculations for NaOH orifice sizing assume that the storage tank is at atmospheric pressure. These calculations do not consider a pressure drop for the NaOH tank vacuum breaker check valves or consider the nominal positive pressure condition from nitrogen supplied by the non-safety related nitrogen purging system.
- The calculations of orifice sizing are based on a minimum NaOH tank level to demonstrate the required flowrate is met at the end of NaOH injection. Therefore, in general, calculated NaOH flowrates will tend to be low and the actual spray flow pH will tend to be somewhat higher than that calculated.
- There is no calculation margin to account for flow variance outside an eductor flow range of 16.5 to 18.0 gpm.

The above calculation issues primarily impact the eductor flow under conditions when the NaOH tank is not at atmospheric pressure. As the final sump pH of 8.5 to 11.0 is not dependent on the eductor flow rate, the final sump pH is not adversely affected provided the total NaOH tank volume is delivered to the containment.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
St. Lucie Unit 1	05000335	1999	- 001	- 00	Page 7 of 10

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

Analysis of the Event (cont'd)

Based on the above issues, it is concluded that the original IRS design approach primarily assures a final sump pH in the required range. However, the design approach does not assure the pH of the containment spray at the containment spray nozzles remains within the required range for all postulated conditions. The surveillance requirements of Technical Specification 4.6.2.2 were satisfied despite the design and IST concerns identified in this LER. However, the basis of Technical Specification 3.6.2.2 is considered not to have been met based on the inability to maintain the UFSAR required pH of 8.5 to 11.0 at the spray nozzles under all conditions. Therefore, this condition constitutes noncompliance with the OPERABILITY requirements for a Limiting Condition for Operation (LCO) (Technical Specification 3.6.2.2) and is reportable under 10 CFR 50.73(a)(2)(i)(B) as "any operation or condition prohibited by the plant's Technical Specifications."

Based on a review of NUREG-1022 Revision 1, the issues identified in this LER do not constitute a reportable condition under 10 CFR 50.72. Specifically, because post accident sump pH ranges remain consistent with the NRC's SER for St. Lucie Unit 1 (as discussed in the following paragraphs), this condition neither represents an unanalyzed condition nor is it outside the design basis of the plant. Additionally, this condition did not represent a single condition which could have prevented the fulfillment of a safety function.

Analysis of Safety Significance

The containment spray system is an engineered safety features system that functions to reduce reactor containment building pressure and temperature and the quantity of airborne fission products in the containment atmosphere subsequent to a loss of coolant accident (LOCA). Sodium hydroxide is added to the containment spray water at St. Lucie Unit 1 to increase the pH which enhances absorption of the airborne fission product iodine, retains the iodine in the containment sump solution, minimizes the production of hydrogen, and inhibits stress corrosion cracking.

Per the SER dated November 8, 1974, the position of the AEC was that additional design features and procedures were required to "increase the pH of the water in the containment to a value of at least 7.0 within about four hours after a postulated LOCA." The SER noted and accepted an FPL plan to install trisodium phosphate dodecahydrate (TSP) stored in four stainless steel mesh baskets in containment.

In the SER supplement dated May 9, 1975, the NRC required that the planned TSP baskets be installed within 36 months. This same SER provided a review of FPL's subsequent proposal to install an NaOH injection system to enhance the iodine scrubbing capability of the containment spray system. The SER supplement required the TSP system to be installed for the time period preceding the availability of the NaOH system for post-LOCA containment sump pH control. In its description of the NaOH system, the SER noted that a sufficient quantity of NaOH would be injected to raise the equilibrium pH in the containment sump to a minimum value of 8.5.

Using a conservative assumption that only one train of NaOH injection is available for the entire four hour period following a LOCA, preliminary FPL calculations show that the containment sump pH will be 8.33, significantly above the original SER criteria of 7.0. Containment sump pH would eventually rise to a value above the current UFSAR 8.5 minimum pH criteria as the eductor continued to draw down the NaOH tank volume.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
St. Lucie Unit 1	05000335	1999	- 001 -	00	Page 8 of 10

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

Analysis of Safety Significance (cont'd)

Regulatory Guide 6.5.2, "Containment Spray as a Fission Product Cleanup System," Revision 2, discusses in Section II.1 g. the acceptance criteria for *Containment Sump and Recirculation Spray Solutions* in the context of design requirements for fission product removal. In part, this section states:

> "The pH of the aqueous solution collected in the containment sump after completion of injection of containment spray and ECCS water, and all additives for reactivity control, fission product removal, or other purposes, should be maintained at a level sufficiently high to provide assurance that significant long-term iodine re-evolution does not occur. Long-term iodine retention may be assumed only when the equilibrium sump solution pH, after mixing and dilution with the primary coolant and emergency core cooling system (ECCS) injection, is above 7. This pH value should be achieved by the onset of the spray recirculation mode."

A 1980 paper presented in the Journal of Inorganic and Nuclear Chemistry is cited by the NRC as a reference for the pH value of 7.0. Revision 2 to Regulatory Guide 6.5.2 was issued in December 1988, subsequent to the licensing of St. Lucie Unit 1.

Later, in Section III.4.c of the regulatory guide, the NRC discusses a method of evaluation acceptable to assess the effectiveness of the containment spray system in removing fission products. This section cites several references for the following statements:

> "Experimental results and computer simulations of the chemical kinetics involved show that an important factor in determining the effectiveness of sprays against elemental iodine vapor is the concentration of iodine in the spray solution. Experiments with fresh sprays having no dissolved iodine were observed to be quite effective in the scrubbing of elemental iodine even at a pH as low as 5. However, solutions having dissolved iodine, such as the sump solutions that recirculate after an accident, may revolatilize iodine if the solutions are acidic. Chemical additives in the spray solution have no significant effect upon aerosol particle removal because this removal process is largely mechanical in nature."

The references cited include the results of experiments performed at Pacific Northwest Laboratories and a report on; *The Absorption of Gaseous Iodine by Water Droplets*, prepared by the NRC. This section goes on to conclude that, during injection, the effectiveness of the spray against elemental iodine vapor is chiefly determined by the rate at which the fresh solution surface area is introduced into the containment building atmosphere.

As noted in the regulatory guidance, these minimum pH levels provide assurance that volatile fission products will be scrubbed from the containment atmosphere during injection and will not be re-evolved into the containment atmosphere from the sump solution during recirculation.

Preliminary calculations performed by FPL, assuming that only one train of NaOH injection is operable while two trains of containment spray are operating in the injection mode, show that the spray flow pH will be 7.38, well above the pH criteria of 5.0. Although calculations using the same conditions show that the sump pH will be 5.8 at the onset of recirculation, which is not in accordance with the above 7.0 guideline, final equilibrium sump pH would shortly be within the required band of 8.5 to 11.0.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
St. Lucie Unit 1	05000335	1999	- 001	- 00	Page 9 of 10

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

Analysis of Safety Significance (cont'd)

FPL concludes the above discussion supports a determination that the identified deficiencies were not safety significant:

1. Although the nitrogen supply for the IRS NaOH tank does not meet safety related system requirements, this system is normally in service to maintain a nitrogen overpressure as described within the UFSAR. Accordingly, it is reasonable to conclude the IRS would have operated during a LOCA to provide sufficient buffering agent to reach a final sump pH of between 8.5 and 11.0 and to maintain spray flow pH greater than 8.5 during injection and recirculation.

2. If the IRS NaOH tank's nitrogen overpressure was not available, NaOH delivery flow would decrease as the eductor became less efficient due to a lower-than-design suction side pressure. However, as long as the required amount of NaOH is added, the final equilibrium sump pH would eventually be within 8.5 and 11.0.

   - Based on the size of the vacuum breaker valves, it is likely they would cycle until the NaOH tank was isolated on low level or by manual action by Operations.

   - Low or erratic NaOH flow would be identified under LOCA accident conditions by emergency operating procedure 1-EOP-03, "Loss of Coolant Accident," which direct use of Table 3 within 1-EOP-99, "Appendixes/Figure/Tables," to verify proper operation of containment spray system equipment, including NaOH flow as indicated and recorded in the control room on FI-07-2 and FR-07-2.

   - As discussed above, iodine removal by the containment spray is mechanical in nature and is not adversely affected by the pH of the spray flow. The timing of NaOH addition to the spray flow is not an immediate concern; the final sump pH will be within the required bounds.

3. The original SER requirements allowed interim plant operation without any pH buffering systems installed.

The present condition with the NaOH tank nitrogen overpressure removed and vent valve V07233 open on an Equipment Clearance Order (ECO) is acceptable. The nitrogen overpressure does not serve a safety-related function and this configuration returns the IRS system to a condition bounded by system calculations. The vented tank configuration is used by other utilities with success, and has been previously used by St. Lucie Unit 1 without noted chemistry control issues. The current field configuration (vent valve V07233 open on a clearance) is acceptable and meets system operability requirements. The configuration is deemed acceptable for an interim period until a long term solution is developed and approved for implementation.

Based on the above, there was no significant impact on the health and safety of the public.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
St. Lucie Unit 1	05000335	1999	- 001	- 00	Page 10 of 10

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

Corrective Actions

1. NaOH tank vent valve V07233 was tagged open to ensure the NaOH tank is at atmospheric pressure. This assures that the IRS NaOH tank operating conditions are bounded by the system design calculations.
2. FPL is developing a long term solution to address the design problems associated with the Unit 1 IRS.
3. FPL performed another review of outstanding issues pertaining to check valve full flow IST surveillance requirements and no other issues were identified as an operability or potentially reportable concern.
4. FPL is performing a design review of other important to safety tanks that use lift check valves as vacuum breaking devices to determine if similar design deficiencies exist.

Additional Information

The NaOH tank vacuum breaker valve V07232 was determined to not open with 15 psig nitrogen pressure during its last surveillance test on March 9, 1999. This is the third failure of a NaOH vacuum breaker valve within a two year period. In each case, NaOH deposits have been discovered within the valve internals preventing the valve from operating smoothly, and the valves were worked, re-tested, and returned to service. Reorientation of check valves to a stem-up configuration has been performed in two steps in an effort to reduce the effects of NaOH deposition. This approach has not been successful. The change in valve stem orientation changes the dynamics of valve operation, but does not account for the valve test failure. Inspections of the valve internals for the current failure and for past failures have not identified any valve anomalies other than NaOH deposits which prevented valve actuation.

The cause of the NaOH deposits found within the valves was determined to be aspiration due to nitrogen sparging. Sparging is typically performed in conjunction with chemical addition and monitoring. The NaOH is theorized to become airborne as a mist caused by bubble explosion/splashing as the nitrogen is bubbled from the sparger located near the tank's bottom. Should the vacuum breaker valves be leaking, the NaOH mist could be additionally transported by the nitrogen leakage flow through the valve. This failure mechanism is time dependent, and on each previous failure, the redundant valve passed its surveillance testing.

Based on a review of NUREG-1022 Revision 1, despite the earlier failures, it is appropriate to consider the most recent failure as occurring at time of discovery. All other Technical Specification surveillance requirements have been satisfied at this time. Because the appropriate LCO actions of Technical Specification 3.6.2.2 were taken at time of discovery, there are no reportability concerns related to the recent NaOH tank vacuum breaker test failures.

Failed Components Identified

None

Similar Events

None